

MEMORANDUM
RM-5636-DOT
APRIL 1968

MEDICAL PROBLEMS AND
PHYSICAL FITNESS AS RELATED TO
OCCURRENCE OF TRAFFIC ACCIDENTS

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PREPARED FOR:
NATIONAL HIGHWAY SAFETY BUREAU
FEDERAL HIGHWAY ADMINISTRATION
DEPARTMENT OF TRANSPORTATION

The **RAND** *Corporation*
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PREFACE

Under Contract FH-11-6698, The RAND Corporation has made a preliminary study of highway safety measures for the National Highway Safety Bureau (NHSB), Department of Transportation. The objective of the work was to review knowledge on the causes of motor vehicle accidents, to relate these causes to the production of injuries and to operational and environmental variables, and to define a program for developing a conceptual framework into which may be fitted safety-oriented research activities and their supporting resources.

The results of this study are contained in seven reports in the RAND Memorandum series:

RM-5631-DOT, Putting the Analysis and Evaluation of Traffic Safety Measures into Perspective, by Martin Wohl

RM-5632-DOT, A Conceptual Framework for Evaluating Traffic Safety System Measures, by Martin Wohl

RM-5633-DOT, Modeling the Traffic-Safety System, by Bruce F. Goeller

RM-5634-DOT, Vehicle Safety: Why the Market Did Not Encourage it and How it Might Be Made to Do So, by Alan Carlin

RM-5635-DOT, Alcohol and Traffic Accidents, by H. H. Mitchell, M.D.

RM-5636-DOT, Medical Problems and Physical Fitness as Related to Occurrence of Traffic Accidents, by H. H. Mitchell, M.D.

RM-5637-DOT, Emergency Medical Care and Traffic Fatalities, by H. H. Mitchell, M.D.

Of these seven reports, the first three address the general analytical features of the traffic-safety system and develop a conceptual framework for a system model. An evaluation framework is also provided, as well as suggestions for research to make the system analysis and evaluation scheme operational. The remaining four reports provide supporting data on economic, medical, and physiological factors related to traffic accidents.

SUMMARY

This report summarizes the rather meager material found in the published literature on medical problems as it relates to the occurrence of traffic accidents. Several classifications were considered, namely, chronic medical conditions, sudden illness, suicide, orthopedic physical disability and drug use.

The published data does not provide sufficient evidence for an estimate to be made of the contribution of various medical conditions to the accident rate. There are also insufficient quantitative studies to form a rational basis for action by regulatory authority in charge of licensure for driving. If done at all, the current screening of drivers before licensure (new or renewal) by official and nonofficial means is apparently based on qualitative medical judgment.

It is suggested that controlled studies be done to evaluate the contribution to the accident problem of the various medical conditions which might be significant (e.g., epilepsy, diabetes, cardiac disease, etc.). These studies should determine the effect on the accident rate of removal of specified categories of diseased individuals. Particular attention should be paid to the number of licenses which would have to be denied for each particular category studied.

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I. INTRODUCTION

In attempting to evaluate the importance of various medical factors as contributors to the traffic accident problem some general background information should be kept in mind.

A. INCIDENCE OF CHRONIC CONDITIONS

The number of persons with chronic conditions is considerable.* There are estimated to be over 87 million persons with one or more chronic conditions in a population of 188.5 million people (fiscal year 1965). The age distribution of these conditions is also relevant and as would be expected the percentage increases with advancing age (see Table 1).⁽¹⁾

Table 1

NUMBER AND PERCENT OF PERSONS WITH ONE OR MORE
CHRONIC CONDITIONS IN THE U.S. (FY 1965)

Age	Population in Thousands	Number in Thousands	Percent of Population
Under 17	66,343	14,187	21.4
17-24	21,299	8,406	39.5
25-44	45,299	25,013	55.2
45-64	38,196	25,277	66.2
65 and over	17,292	14,418	83.4
All ages	188,430	87,301	46.3

*Based on questionnaire using a list of chronic conditions which includes, for example, asthma, allergy, heart trouble, stomach trouble, rheumatism, convulsions, hernia, etc. See Ref. (1) for more details.

B. DRIVER SCREENING

There has always been some level of self-screening whereby individuals take or keep themselves out of the driver classification because of physical disability or illness (pedestrian screening is of course different, although pedestrian accidents are considered in the traffic accident totals). Some variable and unknown amount of medical screening has taken place by way of advice to patients on the advisability of driving. Also there have been and are various medical screening programs for bus drivers, truckers, etc. According to Waller⁽²⁾ there are now 17 states that regulate, to some degree, drivers with specific chronic medical conditions. (All states, by now, have at least some regulations regarding vision.) The contribution of these screenings to accident prevention has not been adequately analyzed and their degree of effectiveness is not known.

C. PHYSICAL FITNESS STANDARDS

In 1957 McFarland and Moore⁽³⁾ stated that "The questions of physical fitness to drive and the minimum physical standards for obtaining a driving license are of special interest to physicians.... For the most part the recommendations made represent good professional opinions, but the standards proposed have not been systematically developed as cut-off points based on accident data or measures of driving proficiency."

In 1959 the Committee on Medical Aspects of Automobile Injuries and Deaths (American Medical Association) published a "Medical Guide for Physicians in Determining Fitness to Drive a Motor Vehicle."⁽⁴⁾ This guide was almost entirely qualitative in the nature of the judgments it recommended.

In 1960 the state of Pennsylvania started a program requiring medical examinations of drivers. According to Wilbar⁽⁵⁾ standards were developed by the Pennsylvania Medical Society which were based on "armchair analysis."

Nothing has come to the author's attention to suggest that the above three paragraphs do not represent the current state of affairs.

D. MEDICAL CONDITIONS AND THE ACCIDENT RATE

In 1959 the National Safety Council published an estimate (1958 experience) of the incidence of medical conditions (drinking was excluded) in traffic accidents.⁽⁶⁾ Table 2 presents this data. If we leave out the effects of "fatigue" and "asleep", we see that there were medical conditions and physical defects in 2.3 percent of driver fatalities. The comparable figure for pedestrian deaths is 9.7 percent. If we consider all accidents, drivers with medical conditions and physical defects (omitting "asleep" and "fatigue") account for 1.2 percent of the total. The comparable pedestrian figure for pedestrian accidents is 3.6 percent. The considerable over representation of medically or physically handicapped individuals in the more serious accidents is worthy of note.

Table 2
CONDITIONS OF DRIVERS AND PEDESTRIANS
IN TRAFFIC ACCIDENTS, 1958

Condition [†]	Driver				Pedestrian			
	in Fatal Accidents		in All Accidents		in Fatal Accidents		in All Accidents	
	% of Drivers with Cond.	% of Con- ditions	% of Drivers with Cond.	% of Con- ditions	% of Ped. with Cond.	% of Con- ditions	% of Ped. with Cond.	% of Con- ditions
Total conditions	7.1	100%	2.8	100%	9.7	100%	3.6	100%
Defective eyes	0.3	4	0.2	7	1.7	18	0.8	22
Defective ears	0.2	2	**	2	1.2	12	0.4	12
Defective other	0.8	11	0.4	12	2.7	28	1.1	29
Asleep	3.7	53	1.2	43	***	***	***	***
Fatigued	1.1	15	0.4	16	***	***	***	***
Ill	0.4	6	0.2	6	1.0	10	0.2	7
Other	0.6	9	0.4	14	3.1	32	1.1	30

Source: Based on state traffic reports as follows: drivers--21 states; pedestrians--18 states.

*Excludes drinking

**Less than 0.05

***These items not tabulated for pedestrians.

Kulowski⁽⁷⁾ attempted to assess the contribution of concomitant medical conditions in a series of hospitalized motorist casualties. The data were obtained from a consecutive series of 800 motorist traffic casualties admitted to the Missouri Methodist Hospital (St. Joseph, Missouri) during the years 1949 to 1957. Table 3 shows the conditions he found and Table 4 represents his attempt to allocate the contributory relation to accident causation. His major conclusion was that "Among the 311 patients with pre-existing conditions, at least 9 percent of these people had become involved in highway accidents because of the presence of concomitant disease (almost all in drivers)." It should be noted that he has 23 percent of his cases in the "possible contribution" classification. The presence of alcoholism in his list of concomitant conditions (14 out of 157 drivers and 11 out of 154 passengers) should be noted. This distorts the value of his overall conclusions with regard to the effect of other defects as alcoholism is better evaluated separately because of its likelihood of being a major contributor to the accident incidence.

Table 3

RELATIVE FREQUENCY OF VARIOUS CONCOMITANT CONDITIONS
ACCORDING TO SEATING (When Recorded)

Category of Conditions	Number Present in Drivers	Number Present in Guest Passengers	Not Recorded
Bone and joint	89	93	(70)
Genitourinary	43	37	
Cardiovascular	16	17	
Respiratory	18	13	
Alcoholism	14	11	
Gastrointestinal	13	6	
Miscellaneous	12	6	
Anemia	5	8	
Diabetes mellitus	5	6	
Other metabolic	2	2	
Neurologic	5	3	
Epilepsy	2	1	
Ocular	5	0	
Psychiatric	3	4	
Total	157	154	
Percent	50	50	

Table 4

DEGREE OF CONTRIBUTION TO ACCIDENT CAUSATION (THEORETICAL)
BY CONCOMITANT CONDITIONS--AGE SPECIFIC FREQUENCY

Age (year)	Number of Patients with Concomitant Conditions	No Contribution (0)	Possible Contribution (+)	Definite Contribution (+)	Definite Contribution %
0-9	3	3			
10-19	21	14	7		
20-39	85*	70	9	7	8
40-59	108*	75	23	12	11
60 and over	77	44	28	5	6
Not recorded	17	11	3	3	18
Total	311	217	70	27	
Percent			23	9	

* Slight discrepancy in total figure or subsets left uncorrected as per reference.

A few other overall statistics may be mentioned:

(a) In the United Kingdom, in 1958, police reports indicated 992 out of 165,832 traffic accidents (0.6 percent) involved illness or physical defect as a contributory cause (cited in Ref. 8).

(b) In the German Federal Republic, 1957, according to official reports 0.25 percent of road accidents involved drivers with ill health or bodily defects as contributing factors. An estimate as high as 2 percent was suggested as being closer to the truth if expert medical examiners had done the reporting (cited in Ref. 8).

II. PHYSICAL FITNESS

As we consider the problem of physical fitness and driver licensure, two questions should be in the forefront for consideration:

- 1) How many licenses would be revoked by a particular program.
- 2) What would be the effect on the accident rate (the individuals themselves and other persons considered separately).

A. THE A.M.A. MEDICAL GUIDE

The American Medical Association, as previously mentioned (Ref. 4) published a "Medical Guide for Physicians in Determining Fitness to Drive a Motor Vehicle."* The discussions in this report are divided into six major divisions and several subdivisions as shown in the following chart:

Medicine

Assessing Safe Driving Ability
Metabolic Diseases
Drugs
Fatigue
Fever and Infectious Diseases
Carbon Monoxide
Cardiovascular Disease
Etiological and Anatomic Classification
Physiological Abnormalities

Ophthalmology

Visual Acuity
Visual Fields
Ocular Muscle Imbalance
Color Blindness
Dark Adaptation
Depth Perception

Otolaryngology

Surgery and Orthopedics

Specific Requirements
Head and Neck Movements
Thoracic Region of the Spine
Lumbar Region of the Spine
Upper Extremities
Lower Extremities
Stability of Joints

Neurological, Emotional, and Psychiatric Disorders

Neurological Disorders
Emotional Disturbances
Psychiatric Disturbances

Alcohol

Pharmacology
Alcohol and Driving Ability
Alcohol Consumption and Blood
Alcohol Level
Rate of Oxidation and Elimination
Measurement of Blood Alcohol Levels
Physician's Advice on Drinking
and Driving

*Prepared by the Committee on Medical Aspects of Automobile Injuries and Deaths, American Medical Association.

The stated purpose of this guide is to call attention to those areas where the medical profession can be of help to patients regarding advisability of driving a motor vehicle. It becomes obvious that almost everyone at some time or other, for at least a limited period of time, should be advised not to drive a car. The report, however, is quite vague in giving quantitative statements for threshold values to be used in driving interdiction. The report also discusses, with equal emphasis, conditions which are extremely rare as well as those which are extremely common. The report makes good medical sense when used in the patient-doctor relationship. However, the lack of quantitative statements reflects the true lack of knowledge in the field and the difficulty involved in translating the medical advice into "statutory" requirements. As cardiovascular conditions are very common and of great importance in the medical condition-accident cause relationship one conclusion of this section is quoted. "The lack of conclusive statistical data concerning the role of each cardiac condition as a potential driving hazard is recognized. However, on the basis of knowledge of pathological physiology and the clinical course of these cardiac conditions, it is believed that a medical opinion can be formulated as to the potential driving hazard."

It would be of some interest to know to what extent doctors have given advice on driving interdiction and to what extent this advice has been followed. A study of this kind might help us in evaluating programs which suggest using the doctor as a screening base to limit or exclude the medically dangerous driver.

B. THE PENNSYLVANIA PROGRAM

On June 1, 1960 the state of Pennsylvania started requiring medical examinations based on standards developed by the Pennsylvania Medical Society ("Standards Based on Armchair Analysis").⁽⁵⁾ Tables 5 and 6 show the results obtained during the first year of operation. 0.14% of drivers and applicants were rejected on medical grounds. (This increases to 0.19% if those refusing examinations are included.)

Table 5

DRIVERS AND APPLICANTS FOR DRIVERS' LICENSES TAKING THE REQUIRED MEDICAL EXAMINATIONS AND NUMBER AND PERCENT REJECTED FOR DISABILITIES, BY AGE GROUP, PENNSYLVANIA, JUNE 1, 1960, TO JUNE 1, 1961

Age (years)	Drivers and Applicants		Rejected	
	Number	Percent of total group	Number	Percent of age group
All ages	421,857	100.0	602	0.14 *
16-20	151,857	36.0	108	.07
21-30	70,340	16.7	37	.05
31-40	69,970	16.6	59	.08
41-50	55,351	13.1	56	.10
51-60	43,949	10.4	53	.12
61-93	30,327	7.2	239	.79
Not stated	63		50	

*Up to .19% if those refusing examination are included.

Table 6

DISQUALIFYING CONDITIONS OF 602 DRIVERS AND APPLICANTS FOR DRIVERS' LICENSES WHO FAILED THE REQUIRED MEDICAL EXAMINATION FOR DRIVERS, PENNSYLVANIA, JUNE 1, 1960 TO JUNE 1, 1961

Disqualifying condition	No. of Cases
Loss of use of both hands	3
20/70 vision or less in better eye, with correction	61
Neurological disorders, such as to prevent responsible control of a motor vehicle	68
Any cardiac or circulatory disorder, including hypertension, such as to prevent responsible control of a motor vehicle	97
Neuropsychiatric disorders, such as to prevent responsible control of a motor vehicle	42
Conditions causing repeated lapses of consciousness	79
Alcoholism	31
Narcotic addiction	4
Uncontrolled diabetes	25
Uncontrolled epilepsy	15
Lacks intellectual maturity	8
Doctor stated applicant unfit	47
Voluntary withdrawals	133
Total	613*

*Some persons had more than one disqualifying condition.

A later report⁽⁹⁾ stated that the driver licensing program was using ten conditions of severe mental or physical impairment as cause for refusal to issue or renew a license. In general they are pathological processes or conditions which medical opinion states may cause lapse of consciousness, loss of postural control or loss of vision.

From June 1960 to June 1964 (4-year period) over a million new examinations were given. The rejection rate was 0.04% in the 16-year age group and rising to 0.7% in the 61 to 93-year age group. In the same period of time the renewal plus new examination groups together constituted almost two million persons. 30,000 or 1.7% failed the examination (includes voluntary withdrawals without taking exam).

C. THE IMPAIRED DRIVER IN CALIFORNIA

West⁽¹⁰⁾ reported an interesting study of the impaired driver problem in California. The incidence of physical disabilities and other medical characteristics in Californians of driving age is shown in Table 7. West cautioned that "it is not known to what degree, if any, these conditions in drivers contribute to accidents."

In the interpretation of the data in Table 7 it is important to know that there are over 8 million drivers in California. 72% of the driving age population have valid licenses (99% of men between 25-64 years of age have valid licenses).

West has examined the effect of applying the Pennsylvania medical examination program in California. There would be, according to her, about 11,000 rejected among the 8+ million drivers. If we consider that in 1960 there were 300,000 drivers in trouble (77,000 drivers killed or injured in traffic and 240,000 classified as negligent) a medical examination which selects out only 11,000 drivers from the population of over 8 million is "neither efficient nor sensitive."

West agrees that the driver with physical impairments that are obviously a driving interdiction should not be licensed. Yet doing 12,000 to 15,000 examinations (new and renewal applicants) each working day does seem to be a burdensome and expensive way to find them.

Table 7

ESTIMATES OF INCIDENCE (IN CALIFORNIANS OF DRIVING AGE)
OF PHYSICAL, SOCIAL AND MENTAL CONDITIONS THAT MIGHT
CONTRIBUTE TO AUTOMOBILE ACCIDENTS

1,700,000	Physical disabilities* (includes hearing, vision, orthopedic and speech impairments). Includes: 420,000 impaired hearing (2/5 over 65 years) 7,000 totally deaf 210,000 impaired vision 24,000 totally blind (most are over 65 years) 410,000 orthopedic handicaps (limbs, trunk, or back impaired) 22,000 absence of major extremities
700,000	Estimated number of problem drinkers. Five out of eight are men. (100,000 of these are advanced alcoholics with serious physical complications.)
160,000	Estimated number with history of admission to a state mental hospital for mental illness during past ten years including resident population of state mental hospitals.
100,000	Estimated number of mentally defective (10 percent are in state hospitals; remainder mostly in general population).
100,000	Estimated number with known heart disease (1/2 in persons over 65 years; 60 percent in men).
80,000	Estimated number of known diabetics (60 percent women).
40,000	Estimated minimum number with epilepsy.
20,000	Estimated number of persons discharged from state prisons during last four years or now on parole (95 percent are men).
12,000	Estimated number of narcotic addicts (80 percent male).
2,900,000	Total conditions listed.**

*This number represents conditions, not people, since one person can have several of the conditions listed.

**This number represents conditions, not people, since one person can have several of the conditions listed. It is not known how many of the above conditions are represented by licensed vehicle operators or what effect the conditions may have on ability to drive safely. However, it is not unlikely that 75 to 95 percent of these conditions occur in licensed drivers. All but one of the conditions occur more often in men and 90 percent of men are licensed (99 percent between 25 and 65 years).

California regulates the driving privileges of persons with certain chronic conditions. Waller⁽¹²⁾ has reported on the functioning of this aspect of driving licensure. The chronically ill people came to the attention of the Department of Motor Vehicles by:

- a) Information given by driver applicant
- b) Reporting under epilepsy-reporting law
- c) Reporting under drug addiction reporting law
- d) Voluntary reporting of police, relatives, etc.
- e) By traffic accident or violation reports in which person states he had a medical condition.

Table 8 shows the initial action taken on 2,160 cases of persons with medical conditions reviewed by the California Department of Motor Vehicles. Approximately 50 percent of these people had their licenses revoked.

Table 8

INITIAL ACTION TAKEN ACCORDING TO MEDICAL CATEGORY FOR PERSONS
WITH MEDICAL CONDITIONS REVIEWED BY THE CALIFORNIA
DEPARTMENT OF MOTOR VEHICLES

<u>Medical Category</u>	<u>Initial Action</u>			<u>Totals</u>
	<u>Revoca- tion</u>	<u>No Revo- cation</u>	<u>Unknown</u>	
	%	%	%	%
Epilepsy	61	34	6	100 (580)
Cardiovascular disease	39	60	2	100 (231)
Diabetes	26	71	3	100 (287)
Alcoholism	54	40	8	100 (319)
Drug Usage	68	28	4	100 (352)
Mental Illness	46	47	8	100 (292)
Miscellaneous	31	62	7	100 (99)

Waller states that the administration of programs regulating the driving privilege of people with medical handicaps is difficult. In the absence of validated criteria to assist the physician in assessing

the question of driving fitness, tentative guidelines have been taken from the literature (including the American Medical Association report mentioned above) and are the basis for many of the current regulatory procedures.

III. MEDICAL DISABILITY AND ACCIDENTS

A. CHRONIC MEDICAL CONDITIONS

A study by Ysander⁽¹¹⁾ in Sweden involved 612 drivers with chronic disease: mainly diabetes, cardiovascular disease, renal disorders, and diseases of the sense organs. These were all the drivers in the area selected for study who had been granted a conditional license owing to chronic disease. These drivers were investigated with regard to their accident and serious offense record during a 10-year period. Only 4 (0.8%) road accidents attributable to chronic disability occurred. All accidents were due to hypoglycemia attacks in insulin-treated diabetics.

The chronic disease group was compared to a control group (similar with respect to sex, age, duration of license holding and miles driven). The percentage of drivers experiencing road accidents was 4.1 percent in the disease group and 7.7 percent in the control group. For accidents and serious offenses together the figures were 9.8 percent and 15.3 percent respectively.

This study supports the conclusion that the Swedish system of restrictive rules in licensing of chronically diseased drivers offsets any increased risk due to the diseased condition.

In view of the results of this study a brief description of the ruling principles involved in granting licenses to persons with chronic impairment of health is in order.

Principles laid down by the Royal Board of Health:⁽¹¹⁾

A. Physical Conditions with Potential Risk of Progression

Diabetes Mellitus - The disease must be well balanced and treatment with insulin or tablets well established. Ten years after the onset of the disease a review takes place, based on the presentation of certificates from the physician responsible for the treatment and from an eye specialist. After 15 years such a review takes place every other year. If retinal changes are found, a medical certificate must be presented every year. Applications for driving licenses valid for omnibuses and other commercial vehicles are granted only in cases of a mild form of the disease.

are given in Tables 9 and 10.

Table 9

AVERAGE ACCIDENT AND VIOLATION RATES ACCORDING TO AGE FOR PERSONS WITH MEDICAL CONDITIONS REVIEWED BY THE CALIFORNIA DEPARTMENT OF MOTOR VEHICLES AND FOR A COMPARISON SAMPLE OF CALIFORNIA DRIVERS NOT KNOWN TO HAVE MEDICAL CONDITIONS

<u>Age</u>	<u>Drivers</u>		<u>Accidents/ 1,000,000 Miles</u>		<u>Violations/ 100,000 Miles</u>	
	<u>With Medical Condition</u>	<u>Com- parison Sample</u>	<u>With Medical Condition</u>	<u>Com- parison Sample</u>	<u>With Medical Condition</u>	<u>Com- parison Sample</u>
15-29	444	389	15.3	11.0	8.2	4.9
30-49	839	707	12.7	5.6	4.4	2.5
50-59	268	294	17.3	7.2	4.6	1.8
60 and over	256	240	24.3	11.4	4.2	3.0

As shown in Table 9 the persons with medical conditions had a higher accident rate than the control group in all age categories. The 60 and over age group with chronic medical conditions, as would be expected, had the highest accident rate.

Table 10 shows that drivers with diabetes, epilepsy, cardiovascular disease, alcoholism, and mental illness averaged about twice as many accidents per 1,000,000 miles of driving as the control group.

The study also reported (but did not quantify) that the accident rates were further increased for those with more severe illness, and those with a past history of an accident or violation related to the medical condition.

The difference between these results and those reported by Ysander for Sweden (see page 12 above) is interesting and might well suggest study of the Swedish system in more detail.

Table 10

OBSERVED AND EXPECTED THREE-YEAR ACCIDENT AND VIOLATION RATES
 ACCORDING TO DIAGNOSTIC CATEGORY FOR DRIVERS WITH MEDICAL
 CONDITIONS REVIEWED BY THE CALIFORNIA DEPARTMENT
 OF MOTOR VEHICLES

<u>Diagnostic Category</u>	<u>Driving Exposure</u> 1,000,000 mi	<u>Accidents</u>		<u>Violations</u>	
		<u>Expected*</u> /1,000,000 mi	<u>Observed</u> /1,000,000 mi	<u>Expected*</u> /100,000 mi	<u>Observed</u> /100,000 mi
Epilepsy (445)	11.1	8.2	16.0	3.4	4.7
Cardiovascular disease (216)	5.5	9.0	14.6	2.7	3.6
Diabetes (257)	9.0	8.7	15.5	3.3	4.6
Alcoholism (261)	8.2	6.8	11.3	2.5	4.6
Drug usage (306)	10.4	8.4	8.6	3.6	6.4
Mental illness (231)	6.9	7.2	15.3	3.0	5.3
Miscellaneous (86)	2.2	7.4	20.7	2.8	4.9

*Expected rates are age adjusted

B. SUDDEN ILLNESS

Peterson⁽¹³⁾ in 1962 reported on a study of sudden death among automobile drivers. This study included accidents in and around Baltimore, Maryland (4-year period ending December 31, 1960) and was limited to accidents where the driver was at fault.

There were 192 deaths due to "driver at fault" accidents, 156 were trauma deaths and 36 were non-traumatic deaths. There were also 45 non-traumatic deaths without accidents (driver able to stop car before accident occurred). Cardiovascular disease was responsible for all but one of the 81 non-traumatic deaths. It is interesting that no serious injuries to other people were caused by the sudden deaths of the drivers.

Herner⁽¹⁴⁾ examined one region of Sweden for the years 1959 to 1963 and found 41 accidents due to sudden illness in 44,255 road accidents. Most of the cases were due to epilepsy or myocardial infarction. Eight drivers of the 41 died at the wheel. No other persons were killed

in these 41 accidents although 14 additional drivers were injured along with 7 other non-drivers. In the whole series 118 drivers died.

The California State Department of Highway Patrol recently published some figures on organic factors in single vehicle accidents.⁽¹⁶⁾ The study was limited to accidents in which the driver died within 15 minutes. (Time period: November 1963 to October 1965). Out of 1474 deaths, 155 (10.5%) were driver deaths from natural causes. Of the 155 deaths from natural causes, 144 or 92.9% were heart related.

1,319 drivers were classified as dying from the traffic accident (1474 - 155 = 1319). 65 (4.9%) had evidence of physical disability. 4 cases were reported as having a seizure of some kind which was officially indicated as having precipitated the accident. Of the 65 drivers with disability, 29 or 44.6% were heart related. A causative role was not established in these cases.

Suicide by automobile may be looked on as a sudden death. In any event the subject is worth mentioning and deserves further study as it may be of considerable significance.

Haight⁽¹⁷⁾ reviewed the literature and reported three positive studies having a very wide quantitative range (negative studies also in literature):

- (a) 3 out of 746 suicides were traffic deaths.
- (b) 70% of people contemplating suicide plan to do it by automobile.
- (c) 1 in 21 suicides uses the automobile.

Haight's own study concluded that there is an overlap between the suicide and traffic death classification but that the degree of overlap was unknown.

MacDonald⁽¹⁸⁾ found 3 cases among 62 deaths where the circumstances suggested suicide. These three cases were former patients of the Colorado Psychopathic Hospital.

MacDonald also was able to find 40 psychiatric patients who attempted suicide (30 cases) or homicide (3 cases) or both (7 cases) by automobile. He gives no indication of the population from which these cases were selected and only makes the statement that suicide or homicide by automobile may be more prevalent than suspected.

The California Department of Highway Patrol study⁽¹⁶⁾ found 12 cases which strongly suggested suicide (out of 1319 traffic deaths) but also stated that it is almost impossible to adequately study this problem from the records.

C. PHYSICAL DISABILITY

Ysander⁽¹⁵⁾ reported on the safety of physically disabled drivers in Sweden (over ten-year period). There were 494 disabled drivers in this group, the majority with loss of function in their legs. Three accidents (0.6%) were recorded which may have been caused by the drivers disability. (In all three, loss of function of the right leg was involved.) In both the disabled group and the control group the accident frequency was 7.1%. Serious traffic offenses were 12.2% in the disabled and 14.8% in the control series.

Ysander concluded that disabled drivers are not an increased hazard in traffic because their cars are suitably modified for them.

No other studies on physically disabled drivers (in the sense of loss of limbs) have come to the author's attention. (One study by Domez and Duckworthy (1963) of the Harvard School of Public Health was not located.)

Disability connected with the eye and the ear have not been included in this paper.

IV. DRUGS AND DRIVING

There are no adequate quantitative statements which can be made from the record with regard to drugs and traffic accidents. Current thinking on the problem is probably adequately expressed by a report approved by the American Medical Association's Committee on "Medical Aspects of Automotive Safety and Council on Drugs."⁽¹⁹⁾

The summary of this report is quoted in full:

The physician must consider what potential hazard a particular medication will have if the patient drives. When prescribing a drug, the physician must keep in mind that he is dealing with continually changing psychological and physiological equilibriae rather than a stable biologic system. It is unfortunate though true that automobile transportation dominates American life, so that being unable to drive may indeed mean an inability to earn a living or enjoy normal recreation. Therefore, judicious choice of drugs often can help to reconcile the patient's needs and traffic safety.

We suggest that the physician not only be aware of potential hazards of particular drugs but that he also approach the problem in the context of the treatment situation. Variables related to the patient himself, such as his type of illness, premorbid effectiveness as a driver, and need to drive, will often affect the drug-hazard issue to a greater extent than drug-inherent variables. A checklist that may be used to encompass important items for such consideration accompanies this article.

An individualized physician-patient approach is feasible along guidelines herein established. The special situation of alcohol and driving, with or without drugs, is probably the only one in which the driving privilege should be categorically denied.

Physicians do not want to act as enforcers of social policy but by assuming the responsibility of educating their patients about drugs and driving safety, they can serve the patient and the community in a realistic way.

V. CONCLUSIONS AND SUGGESTIONS

1. At the outset, it should be stated that the amount of reliable data concerning any of the problems dealt with in this paper is grossly inadequate. More research in the form of adequate data collection is needed.
2. According to the compilation of the National Safety Council for 1958: 2.3% of driver fatalities and 9.7% of pedestrian fatalities are due to medical conditions and physical defects (these figures exclude alcohol problem).
3. Driver licensure programs should be evaluated in terms of the number of licenses which would be revoked and what effect this would have on the accident rate (separate evaluation of effect on first and second party).
4. An attempt should be made to evaluate and quantify current practice of medical advice on driving interdiction. The extent to which this advice is being followed should be determined.
5. The Pennsylvania medical examination program should be evaluated with regard to its effect on accident rates and its costs both in dollars spent and in the extent to which it denies licenses relative to the gains involved.
6. Data from California question the efficiency and sensitivity of the Pennsylvania program of medical examination for all license applicants and renewals.
7. The California program of regulating driving privileges of people with chronic medical conditions should be studied in more detail. It appears to be a program which can be expanded to answer more specific questions than have currently been reported.
8. The effect on the accident rate of taking the revoked license group off the highway should be estimated if possible. This has not been done.

9. The Swedish experience with "chronic disease" drivers should be more adequately checked. If conclusions stand up, their system should be given a trial in the United States. (This system uses restricted licenses.)
10. The California study which shows the increased accident rates by diagnostic categories should be expanded geographically and done with unbiased samples.
11. The limited studies on deaths due to sudden illness suggest that this is not a great problem. This is especially true if we accept the figures that deaths or injuries to second parties are rare. The individual might well be allowed to decide for himself whether he wishes to take the risk of driving.
12. Suicide (and possibly homicide) by automobile is a problem which deserves further study.
13. A Swedish study suggests that orthopedic disability cases do not constitute a traffic hazard as currently handled. This should be checked for U.S. driving conditions.
14. The relationship of drugs to driving is an almost unexplored field as far as quantitative work is concerned. In view of the tremendous amount of drugs consumed in America this is an urgent field for research.

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